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118. **Proposed by J. W. YOUNG, Oliver Graduate Student, Cornell University, Ithaca, N. Y.**

Find the differential equations of the system of parabolas, $y^2=4a^2(x+a^2)$, and of its orthogonal trajectories, and interpret the result. Find also the equation of the system of trajectories.

Solution by J. SCHEFFER, A. M., Hagerstown, Md.

Since it makes no difference whether we have a^2 or a, we use the equation $y^2=4a(x+a)$. The equation of the orthogonal trajectory is, since $dy/dx=2a/y$, $1+\frac{2a}{y}.\frac{dy}{dx}=0$. Since a is variable, we must eliminate it. From the equation of the curve we find $a=-\frac{1}{2}x\pm\frac{1}{2}\sqrt{(x^2+y^2)}$, and substituting this, we have $ydx-xdy\pm dy\sqrt{(x^2+y^2)}=0$.

This being a homogeneous equation, we put $x=vy$, and since $dx=vdy+ydv$, we have $\pm\frac{dv}{\sqrt{(1+v^2)}}+\frac{dy}{y}=0$.

$\therefore\ \pm\log[v+\sqrt{(1+v^2)}]+\log y=\text{constant}$, or, taking the upper sign, $y[v+\sqrt{(1+v^2)}]=c$, or $x+\sqrt{(x^2+y^2)}=c$.

Transposing x and squaring we find $y^2=c(c-2x)$. If we take the lower sign, we find $y^2=c(c+2x)$. In either case the equation is that of a parabola of the same form as the given one. The system of the trajectories is self-orthagonal. In fact, it can be easily shown that a system of confocal conics is self-orthogonal.

Also solved by *G. B. M. ZERR.*

MECHANICS.

122. **Proposed by B. F. FINKEL, A.M., M.Sc., Professor of Mathematics and Physics, Drury College, Springfield, Mo.**

Prove that pressure P applied uniformly to a solid in all directions will reduce its dimensions along three perpendicular axes in ratio $1:1+p-2q$, p being the elongation along one face and q the contraction along the other. [Barker's *Physics*.]

I. **Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.**

Let E=Young's Modulus, η=the ratio of the contractions (parallel to two axes) to the elongation (parallel to the third axis), e=elongation, l=reduced length of one of the perpendicular axes. Then $l(1+e)$ is the original length.

But e is composed of first the elongation parallel to the one axis$=P/E$, and the contraction parallel to the other two axes, each$=\eta P/E$.

$\therefore\ e=(1-2\eta)\ P/E=p-2q$ in the problem.

$\therefore\ l:l(1+e)=l:l(1+p-2q)=1:1+p-2q$.

(See Analysis of Strains and Stresses, *Minchin's Statics*.)